

## **5. SUMMARY OF NON-SELECTED CLEANUP ACTIONS AND JUSTIFICATION FOR THE PROPOSED CLEANUP ACTION**

### **5.1 EVALUATION CRITERIA**

Requirements for evaluating and selecting cleanup actions under MTCA are specified in Chapter 173-340-360 WAC. Criteria to be used in this process are summarized as follows:

- Meet threshold requirements:
  - Protection of human health and the environment
  - Compliance with MTCA cleanup standards and applicable state and federal laws
  - Provision for compliance monitoring
- Use permanent solutions to the maximum extent practicable:
  - Technology preference for cleanup of contamination (in order of decreasing preference):
    - 1) Reuse or recycling
    - 2) Destruction or detoxification
    - 3) Separation or volume reduction followed by (1) or (2)
    - 4) Immobilization
    - 5) On-site or off-site disposal at a permitted facility
    - 6) Isolation or containment with engineering controls
    - 7) Institutional controls and monitoring
  - Short-term and long-term effectiveness
  - Implementability
- Provide for a reasonable restoration time frame
- Possess a cost that is proportionate to the incremental degree of protection achievable over a lower preference cleanup action

### **5.2 COMPARATIVE EVALUATION AND SELECTION OF RECOMMENDED ALTERNATIVE**

The five remedial action alternatives described in the FFS were compared with respect to the MTCA criteria, as shown in Table 5-1. On the basis of this analysis, Alternative 3 (air sparging with soil vapor extraction, partial geomembrane cap, and soil cover) was selected as the recommended cleanup action alternative. The rationale for this selection is summarized as follows:

- Alternative 1 (no action) is not acceptable, because it does not meet cleanup levels for soil or groundwater and provides no mitigation of potential benzene impacts from groundwater to Lake Union. Although the interim action (described in Section 2 of this report) was implemented to remove recoverable benzene oil, residual benzene in the soil pores and dissolved in groundwater greatly minimize the potential for natural attenuation to decrease benzene concentrations in the long term, resulting in an indefinite restoration time frame.

**Table 5-1. Comparison of cleanup action alternatives.**

| Alternatives       | Evaluation Factors  |   |   |                        |  |      |
|--------------------|---|---|---|------------------------|--|------|
|                    | Permanence  |   |   | Restoration Time Frame | Park Use Compatibility and Public Concerns   | Cost |
|                    | Threshold Criteria  | Technology Preference (Rank with Respect to 7 MTCA Preferences)   | Effectiveness and Implementability  |                        |  |      |
| <b>1–No Action</b> | <ul style="list-style-type: none"> <li>Acceptable protection of human health</li> <li>No mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>Does not comply with cleanup standards or applicable laws</li> <li>Does not provide compliance monitoring</li> </ul> | <ul style="list-style-type: none"> <li>7th (lowest), since only institutional controls will be continued</li> </ul> | <ul style="list-style-type: none"> <li>Does not meet cleanup levels for soil or groundwater</li> <li>Low short- and long-term effectiveness</li> <li>By definition, fully implementable</li> <li>No reduction of contaminant toxicity, mobility, or volume for impacted soils or groundwater</li> </ul> | Not applicable         | <ul style="list-style-type: none"> <li>No direct effect on current Park use; lack of long-term effectiveness may significantly effect future Park use</li> </ul> | \$0  |

**Table 5-1. Comparison of cleanup action alternatives (continued).**

| Alternatives        | Evaluation Factors  |  |   |   |  |        |
|---------------------|---|--|---|---|--|--------|
|                     | Permanence  |  |   | Restoration Time Frame  | Park Use Compatibility and Public Concerns   | Cost   |
|                     | Threshold Criteria  | Technology Preference (Rank with Respect to 7 MTCA Preferences)                          | Effectiveness and Implementability  |   |  |        |
| <b>2-Soil Cover</b> | <ul style="list-style-type: none"> <li>• Soil cover provides high degree of human health protection</li> <li>• Minimal mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>• Complies with cleanup standards and applicable laws for soil only</li> <li>• Provides compliance monitoring</li> </ul> | <ul style="list-style-type: none"> <li>• 6th for containment of impacted soil</li> </ul> | <ul style="list-style-type: none"> <li>• Meets cleanup levels for surficial soil</li> <li>• Will not meet cleanup levels for groundwater for many years</li> <li>• High short- and long-term effectiveness for isolation of the public from impacted soil</li> <li>• Low short- and long-term effectiveness in mitigating potential benzene impacts from groundwater to Lake Union and meeting cleanup action levels for groundwater over time</li> <li>• No reduction of contaminant toxicity, mobility, or volume for impacted soil or groundwater</li> <li>• Highly implementable</li> </ul> | <ul style="list-style-type: none"> <li>• Short for soil</li> <li>• Indefinite for ground-water</li> </ul> | <ul style="list-style-type: none"> <li>• Significant short-term impacts during construction</li> <li>• Full use of Park during O&amp;M period</li> </ul> | \$2.8M |

**Table 5-1. Comparison of cleanup action alternatives (continued).**

| Alternatives  | Evaluation Factors  |   |  |  |  |        |
|---|---|---|--|--|--|--------|
|   | Permanence  |   |  | Restoration Time Frame   | Park Use Compatibility and Public Concerns   | Cost   |
|   | Threshold Criteria  | Technology Preference (Rank with Respect to 7 MTCA Preferences)   | Effectiveness and Implementability   |  |  |        |
| <b>3–Air Sparging with Soil Vapor Extraction, Partial Geomembrane Cap, and Soil Cover</b> | <ul style="list-style-type: none"> <li>• Soil cover provides high degree of human health protection</li> <li>• Air sparging system provides high degree of mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>• Complies with cleanup standards and applicable laws</li> <li>• Provides compliance monitoring</li> </ul> | <ul style="list-style-type: none"> <li>• 2nd for extraction and thermal destruction of benzene source materials</li> <li>• 6th for containment of soil</li> </ul> | <ul style="list-style-type: none"> <li>• Meets cleanup levels for soil and groundwater</li> <li>• High short- and long-term effectiveness for isolation of the public from impacted surficial soils</li> <li>• Moderate short- and long-term effectiveness for mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>• High degree of reduction of contaminant toxicity, mobility, and volume for impacted soils in the soil cover area</li> <li>• Highly implementable</li> </ul> | <ul style="list-style-type: none"> <li>• Short for soil cover</li> <li>• Short to moderate for air sparging</li> </ul> | <ul style="list-style-type: none"> <li>• Significant short-term impacts during construction</li> <li>• Use of area south of Play Barn restricted occasionally during O&amp;M period of air sparging system (approx. 3 yr)</li> <li>• Area of air sparging system restricted from future Park development during O&amp;M period (approx. 3 yr)</li> </ul> | \$3.6M |

**Table 5-1. Comparison of cleanup action alternatives (continued).**

| Alternatives                                      | Evaluation Factors   |   |  |   |   |        |
|---|--|---|--|---|---|--------|
|   | Permanence   |   |  | Restoration Time Frame  | Park Use Compatibility and Public Concerns  | Cost   |
|   | Threshold Criteria   | Technology Preference (Rank with Respect to 7 MTCA Preferences)   | Effectiveness and Implementability   |   |   |        |
| <b>4-Downgradient Cut-Off Wall and Soil Cover</b> | <ul style="list-style-type: none"> <li>• Soil cover provides high degree of human health protection</li> <li>• Cut-off wall provides high degree of mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>• Complies with cleanup standards and applicable laws</li> <li>• Provides compliance monitoring</li> </ul> | <ul style="list-style-type: none"> <li>• 6th for containment of soil, benzene source materials, and benzene-impacted groundwater</li> </ul> | <ul style="list-style-type: none"> <li>• Meets cleanup levels for surficial soils and groundwater</li> <li>• High short- and long-term effectiveness for isolation of the public from impacted soil</li> <li>• Moderate short-term and high long-term effectiveness for mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>• No reduction of contaminant toxicity, mobility, and volume for impacted soil</li> <li>• Impacted groundwater: high degree of reduction in contaminant mobility; moderate degree of reduction in contaminant toxicity and volume</li> <li>• Highly implementable</li> </ul> | <ul style="list-style-type: none"> <li>• Short for surficial soil cover</li> <li>• Moderate to long for cut-off wall</li> </ul> | <ul style="list-style-type: none"> <li>• Significant short-term impacts during construction</li> <li>• Full use of Park during O&amp;M period</li> <li>• Area of cut-off wall restricted from future Park development during long restoration period</li> </ul> | \$4.3M |

**Table 5-1. Comparison of cleanup action alternatives (continued).**

| Alternatives   | Evaluation Factors   |   |  |  |  |         |
|--|--|---|--|--|--|---------|
|  | Permanence   |   |  | Restoration Time Frame   | Park Use Compatibility and Public Concerns   | Cost    |
|  | Threshold Criteria   | Technology Preference (Rank with Respect to 7 MTCA Preferences)   | Effectiveness and Implementability   |  |  |         |
| <b>5-Excavation of Surficial Soils and Benzene Source with Off-Site Disposal</b> | <ul style="list-style-type: none"> <li>Excavation of impacted soil provides high degree of human health protection</li> <li>Long-term reduction in benzene concentrations in groundwater provide moderate to high degree of mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>Complies with cleanup standards and applicable laws</li> <li>Provides compliance monitoring</li> </ul> | <ul style="list-style-type: none"> <li>5th for off-site disposal of surficial soils and benzene source materials</li> </ul> | <ul style="list-style-type: none"> <li>Meets cleanup levels for soil</li> <li>Meets cleanup action levels for groundwater in the long-term</li> <li>High short- and long-term effectiveness for removal of impacted soil</li> <li>Low short-term and moderate to high long-term effectiveness for mitigation of potential benzene impacts from groundwater to Lake Union</li> <li>Potential toxicity reduction of impacted soil via off-site treatment</li> <li>Moderate to high degree of reduction in toxicity, mobility, and volume of impacted groundwater in the long-term</li> </ul> | <ul style="list-style-type: none"> <li>Short for soil removal</li> <li>Moderate to long for groundwater</li> </ul> | <ul style="list-style-type: none"> <li>Significant short-term impacts during construction</li> <li>Full use of Park during O&amp;M period</li> </ul> | \$19.9M |

- Alternative 2 (soil cover) meets cleanup levels for soil. However, this alternative will not meet cleanup action levels for groundwater and provides no mitigation of potential impacts from groundwater to Lake Union, for the same reasons described above for Alternative 1.
- Alternative 3 (air sparging with soil vapor extraction, partial geomembrane cap, and soil cover) is the recommended cleanup alternative, because it meets cleanup levels in a short time frame and for a cost that is proportionate to the degree of protection to human health and the environment (with respect to the other alternatives).
- Alternative 4 (downgradient cutoff wall) meets cleanup levels for soil and groundwater, but applies a lower technology preference, has only a moderate short-term effectiveness, and requires a longer restoration time frame, at a cost exceeding that of Alternative 3.
- Alternative 5 (excavation of unsaturated soil and benzene source with off-site disposal) provides high long-term effectiveness with respect to removal of impacted unsaturated soil and residual benzene source material in saturated soil but at a cost that is about 5.5 times that of Alternative 3. The incremental cost of this option is substantial and disproportionate to the incremental degree of protection that it would achieve over a cleanup action of equal or lower preference.

## 6. IMPLEMENTATION SCHEDULE

Figure 6-1 presents the planned implementation schedule for the proposed cleanup action described in Section 2. The final design of the cleanup actions will begin with approval of the final Cleanup Action Plan. Construction will begin after final design, contract document (plans and specifications) preparation, and contract bidding.

The items presented as design and construction of cleanup systems include: the air sparging/soil vapor extraction system and impermeable geomembrane cap; subgrade preparation and incidental hot spot removal; and cover soil placement (geotextile, soil, irrigation system, hydroseeding, and surface water management). Post-cleanup monitoring and maintenance will begin immediately after construction is complete.

All durations shown in the proposed implementation schedule are approximate, and are based on information available as presented in this report. Since final design of the cleanup action is yet to be completed, the exact nature of these systems and therefore the time required to implement them cannot be known at this time. The ultimate implementation schedule will therefore be different from the target schedule presented in Figure 6-1.



Figure

6-1 Preliminary Implementation Schedule for Gas Works Park Cleanup Action